Satellite Retrievals of Surface Solar Irradiance

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RESEARCH OBJECTIVES

Marine phytoplankton reproduce on time scales of hours to days. Understanding marine productivity and its role in the ocean's carbon cycle requires surface solar irradiance data on comparable time scales. Our contribution to the NASA SeaWiFS science team is the production and validation of global surface solar irradiance, photosynthetically active irradiance (PAR) and related parameters. Spatial and temporal resolution are 0.5 x 0.5 degrees and 3 hours/daily/monthly, respectively (Figure 1). Bishop, Rossow and Dutton (1997) found excellent agreement (e.g., accuracy better than 8 W m^{-2}) in low-aerosol areas typical of much of the ocean. However, errors as high as 30% were found in aerosol-affected areas (e.g., South China Sea). This work describes irradiance results for 1991 through 1993 and progress on improvement of irradiance accuracy in aerosol-dominated regions. The period 1991-1993 is notable because the effects of aerosols from the Mt. Pinatubo eruption were observed globally.

APPROACH

Surface irradiance is computed using the Bishop, Rossow and Dutton (1997) scheme and DX data from the International Satellite Cloud Climatology Project (ISCCP). Modifications to the scheme include the treatment of ice clouds. ISCCP data began in July 1983 and are derived from multiple polar orbiting and geostationary satellites. NOAA aerosol optical thickness data were used to compute corrections and were applied to our irradiance results.

ACCOMPLISHMENTS

We have performed validation of results against high-quality long-term surface observations. We examined aerosol affects using data from NOAA/PMEL at 0N 140W in the Pacific Ocean. Similarly, we studied a mineral dust-affected area in the subtropical Atlantic Ocean. At the site in the subtropical NE Atlantic, our data (after aerosol correction) are in excellent agreement with ocean mooring observations. The aerosol correction also improved the matchup of data from the equatorial Pacific Ocean; however, after the Pinatubo aerosol declined and the cloud regime shifted in mid-1992, the retrieved irradiance results fell higher than mooring observations by ~10 W m^{-2}. This is due to under-retrieval of scattered clouds smaller than the 4 km pixels sampled by ISCCP.

SIGNIFICANCE OF FINDINGS

Accurate calculations of surface solar irradiance are required for better calculations of marine and terrestrial photosynthesis and for validation of climate models. We have demonstrated a global irradiance product that will span from 1983 to the present.

RELATED PUBLICATIONS

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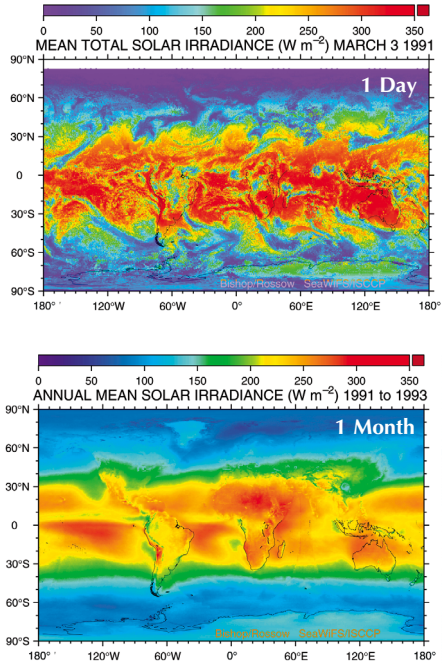

Figure 1. Surface solar irradiance calculated for the globe for 24 hours and 3-year annual average. Marine plant productivity responds to the day-by-day variations in solar irradiance.

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Stowe, L.L., R.M. Carey and P.P. Pellegrino, Monitoring the Mt. Pinatubo aerosol layer with NOAA/AVHRR data, Geophys. Res. Lett., 19, 159-162, 1992 (and updates).

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